

CLAIMS

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1. A raffinose synthase gene isolated from a plant and having a nucleotide sequence coding for an amino acid sequence of a protein capable of producing raffinose by combining a D-galactosyl group through an  $\alpha(1 \rightarrow 6)$  bond with a hydroxyl group attached to the carbon atom at position 6 of a D-glucose residue in a sucrose molecule.

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2. The raffinose synthase gene according to claim 1, wherein the plant is a dicotyledon.

3. The raffinose synthase gene according to claim 2, wherein the dicotyledon is a leguminous plant

4. The raffinose synthase gene according to claim 3, wherein the leguminous plant is broad bean.

5. A raffinose synthase gene having a nucleotide sequence coding for protein (a) or (b) as defined below:

(a) protein having the amino acid sequence of SEQ ID NO:1;

(b) protein having an amino acid sequence derived by deletion, replacement, modification or addition of one or several amino acids in the amino acid sequence of SEQ ID NO:1, and capable of producing raffinose by combining a D-galactosyl group through an  $\alpha(1 \rightarrow 6)$  bond with a hydroxyl group attached to the carbon atom at position 6 of a D-glucose residue in a sucrose molecule.

6. A raffinose synthase gene having the nucleotide sequence of SEQ ID NO:2.

7. The raffinose synthase gene according to claim 3, wherein the leguminous plant is soybean.

8. A raffinose synthase gene having a nucleotide sequence coding for protein (a) or (b) as defined below:

(a) protein having the amino acid sequence of SEQ ID NO:3;

(b) protein having an amino acid sequence derived by deletion, replace-

ment, modification or addition of one or several amino acids in the amino acid sequence of SEQ ID NO:3, and capable of producing raffinose by combining a D-galactosyl group through an  $\alpha(1\rightarrow6)$  bond with a hydroxyl group attached to the carbon atom at position 6 of a D-glucose residue in a sucrose molecule.

9. A raffinose synthase gene having the nucleotide sequence of SEQ ID NO:4.

10. The raffinose synthase gene according to claim 2, wherein the dicotyledon is a lamiaceous plant.

11. The raffinose synthase gene according to claim 10, wherein the lamiaceous plant is Japanese artichoke.

12. A raffinose synthase gene having a nucleotide sequence coding for the amino acid sequence of SEQ ID NO:5.

13. A raffinose synthase gene having the nucleotide sequence of SEQ ID NO:6.

14. The raffinose synthase gene according to claim 1, wherein the plant is a monocotyledon.

15. The raffinose synthase gene according to claim 14, wherein the monocotyledon is a gramineous plant.

16. The raffinose synthase gene according to claim 15, wherein the gramineous plant is corn.

17. A raffinose synthase gene having a nucleotide sequence coding for the amino acid sequence of SEQ ID NO:7.

18. A raffinose synthase gene having the nucleotide sequence of SEQ ID NO:8.

19. A raffinose synthase protein having amino acid sequence (a) or (b) as defined below:

(a) amino acid sequence of SEQ ID NO:1 or SEQ ID NO:3;

(b) amino acid sequence derived by deletion, replacement, modification or

addition of one or several amino acids in the amino acid sequence of SEQ ID NO:1 or SEQ ID NO:3;

the protein being capable of producing raffinose by combining a D-galactosyl group through an  $\alpha(1 \rightarrow 6)$  bond with a hydroxyl group attached to the carbon atom at position 6 of a D-glucose residue in a sucrose molecule.

20. A raffinose synthase protein having the amino acid sequence of SEQ ID NO:1 or SEQ ID NO:3.

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A 21. A gene fragment having a partial nucleotide sequence of the raffinose synthase gene of claim 1, ~~2, 3, 4, 7, 10, 11, 14, 15 or 16~~.

A 22. A gene fragment having a partial nucleotide sequence of the raffinose synthase gene of claim 5, ~~6, 8, 9, 12, 13, 17 or 18~~.

23. The gene fragment according to claim 21 or 22, wherein the number of nucleotides is in the range of from 15 to 50.

A 24. A method for the detection of a raffinose synthase gene or a gene fragment having a partial nucleotide sequence thereof, which comprises hybridizing a probe of the labeled gene fragment of claim 21, <sup>or 22</sup> ~~22 or 23~~ to an organism-derived genomic DNA or cDNA fragment; and detecting the DNA fragment bound specifically to the probe.

A 25. A method for the detection of a raffinose synthase gene or a gene fragment having a partial nucleotide sequence thereof, which comprises hybridizing a probe of the labeled gene fragment of claim 21, <sup>or 22</sup> ~~22 or 23~~ to a plant-derived genomic DNA or cDNA fragment; and detecting the DNA fragment bound specifically to the probe.

A 26. A method for the amplification of a raffinose synthase gene or a gene fragment having a partial nucleotide sequence thereof, which comprises annealing a primer having a nucleotide sequence of the gene fragment of claim 21, <sup>or 22</sup> ~~22 or 23~~ to organism-derived genomic DNA or cDNA; and amplifying the resulting DNA fragment by polymerase chain reaction.

27. A method for the amplification of a raffinose synthase gene or a gene

A fragment having a partial nucleotide sequence thereof, which comprises annealing a primer having a nucleotide sequence of the gene fragment of claim 21, ~~22 or 23~~ to plant-derived genomic DNA or cDNA; and amplifying the resulting DNA fragment by polymerase chain reaction.

A 28. A method for obtaining a raffinose synthase gene, comprising the steps of identifying a DNA fragment containing a raffinose synthase gene or a gene fragment having a partial nucleotide sequence thereof by the method of claim 24, ~~25, 26 or 27~~; and isolating and purifying the DNA fragment identified.

Sub C3 A 29. A raffinose synthase gene obtained by identifying a DNA fragment containing a raffinose synthase gene or a gene fragment having a partial nucleotide sequence thereof by the method of claim 24, ~~25, 26 or 27~~, and isolating and purifying the DNA fragment identified.

Sub A 30. A chimera gene comprising the raffinose synthase gene of claim 1, ~~2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 or 29~~, and a promoter linked thereto.

Sub A 31. A transformant obtained by introducing the chimera gene of claim 30 into a host organism.

Sub A 32. A plasmid comprising the raffinose synthase gene of claim 1, ~~2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 29 or 30~~.

Sub A 33. A host organism transformed with the plasmid of claim 32, or a cell thereof.

34. A microorganism transformed with the plasmid of claim 32.

35. A plant transformed with the plasmid of claim 32, or a cell thereof.

36. A method for metabolic modification, which comprises introducing the raffinose synthase gene of claim 1, ~~2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 29 or 30~~ into a host organism or a cell thereof, so that the content of raffinose family oligosaccharides in the host organism or the cell thereof is changed.

37. A method for the production of a raffinose synthase protein, which comprises isolating and purifying a raffinose synthase protein from a culture obtained by

cultivating the microorganism of claim 34.

38. An anti-raffinose synthase antibody capable of binding to the raffinose synthase protein of claim 19 or 20.

39. A method for the ~~detection~~ of a raffinose synthase protein, which comprises treating a test protein with the anti-raffinose synthase antibody of claim 38; and detecting the raffinose synthase protein by antigen-antibody reaction between the antibody and the raffinose synthase protein.

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